

ISMENIUS CAVUS: ANCIENT LAKE DEPOSITS AND CLAY MINERALS SURROUNDED BY AMAZONIAN GLACIERS

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A biking trip through Mars history!!

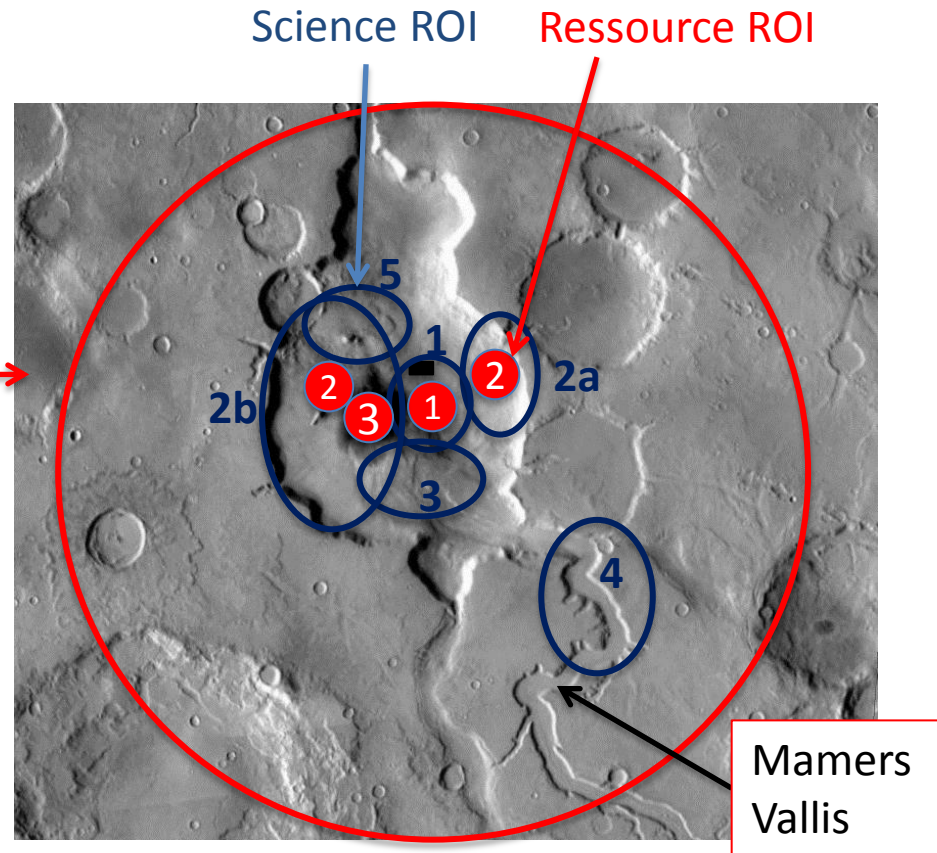
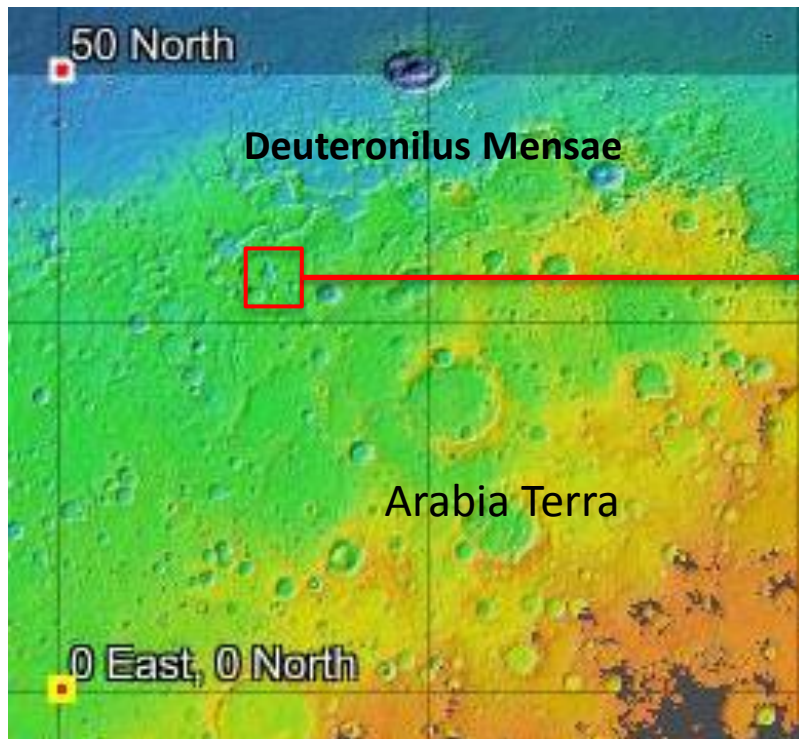
Geographic and geologic context

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Ismenius Cavus: Coord: 33.5°N, 17°E,
Elevation: -3.5 to -1.5 km

At the junction between current mid-latitude ice deposits and low latitude clay minerals



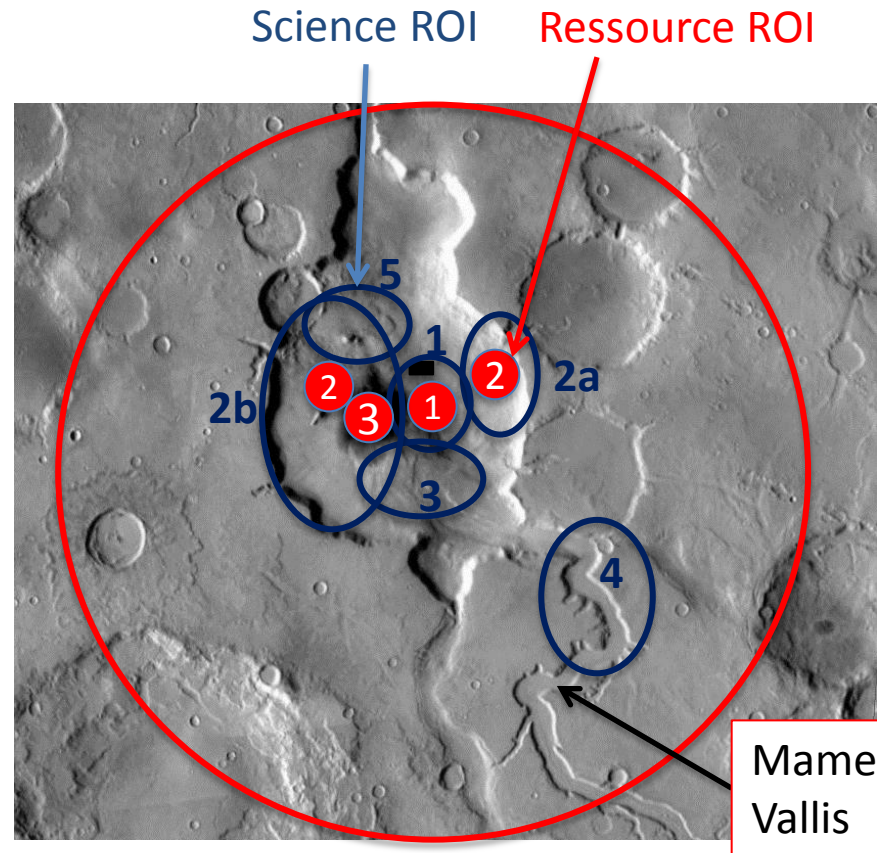
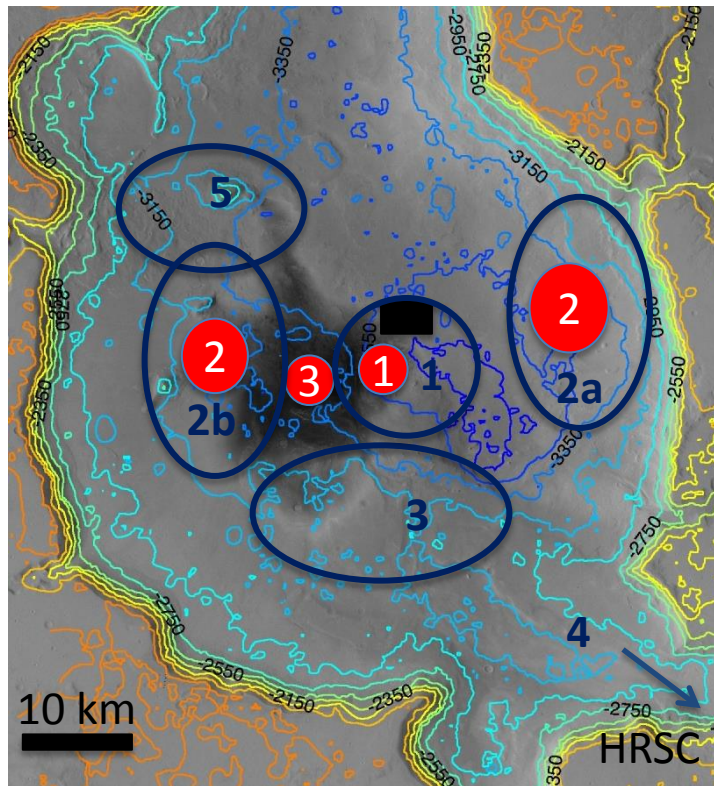
Exploration Zone Map

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Ismenius Cavus: Coord: 33.5°N, 17°E,
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At the junction between current mid-latitude ice deposits and low latitude clay minerals



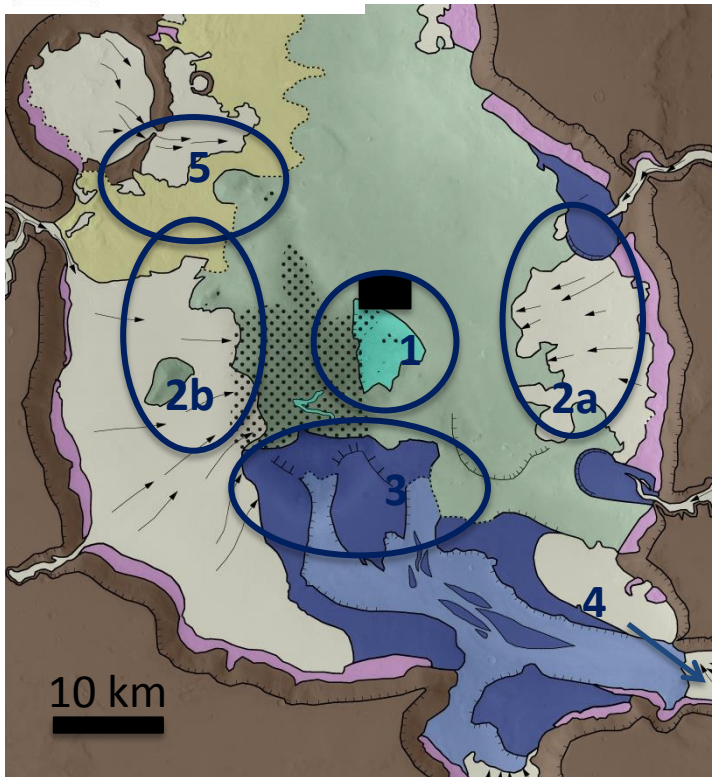
Scientific objectives



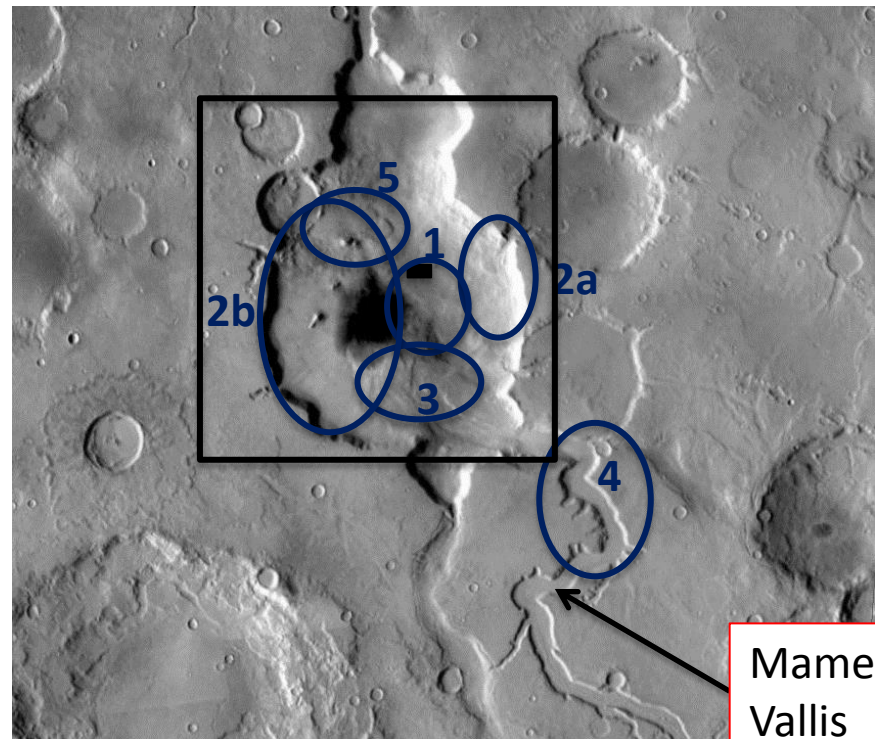
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- | | |
|--|--------------------------------------|
| 2 Glacial landforms | Geologic map caption |
| 5 Modified ejecta blanket | Depression floor |
| 3,4 Channel in the delta deposits | 1 Phyllosilicate-bearing unit |
| 3,4 Delta deposits | Noachian plateau |

At the junction between current mid-latitude ice deposits and low latitude clay minerals



Dehouck et al., Planet. Spa. Sci., 2010



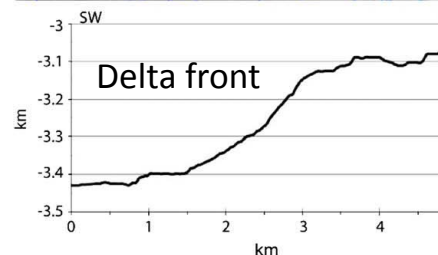
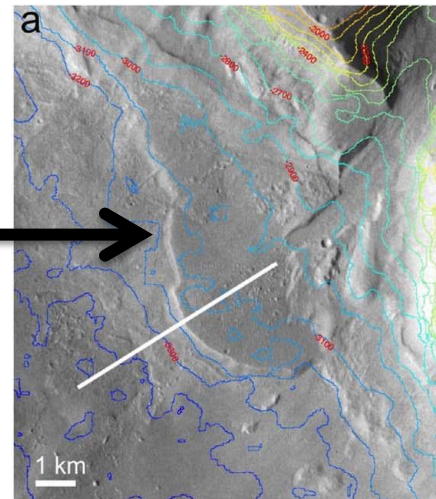
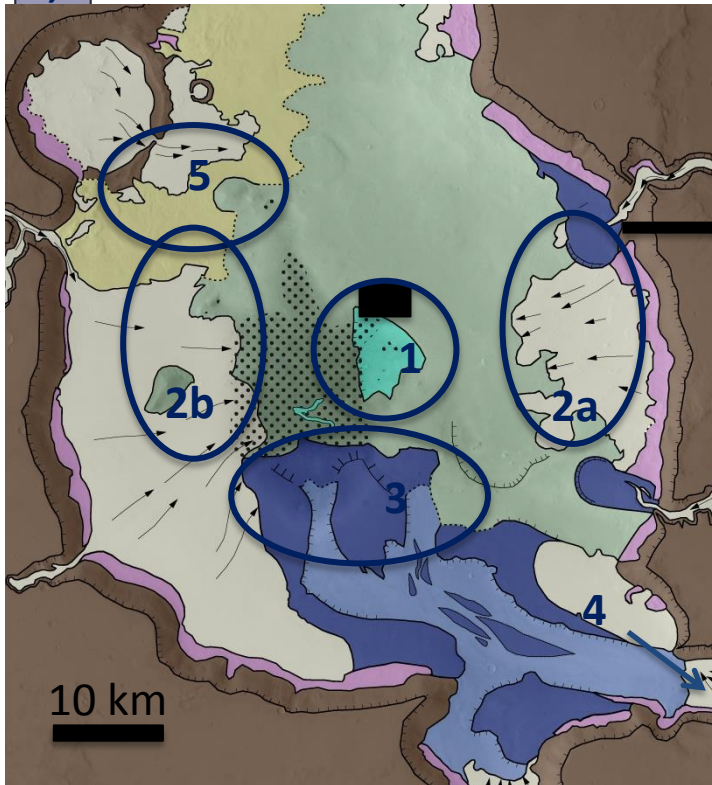
**Mamers
Vallis**

Scientific objectives

1st EZ Workshop for Human Missions to Mars

2	Glacial landforms		Depression floor
5	Modified ejecta blanket	1	Phyllosilicate-bearing unit
3,4	Channel in the delta deposits		Noachian plateau
3,4	Delta deposits		




A paleolake with clay minerals in lake sediments

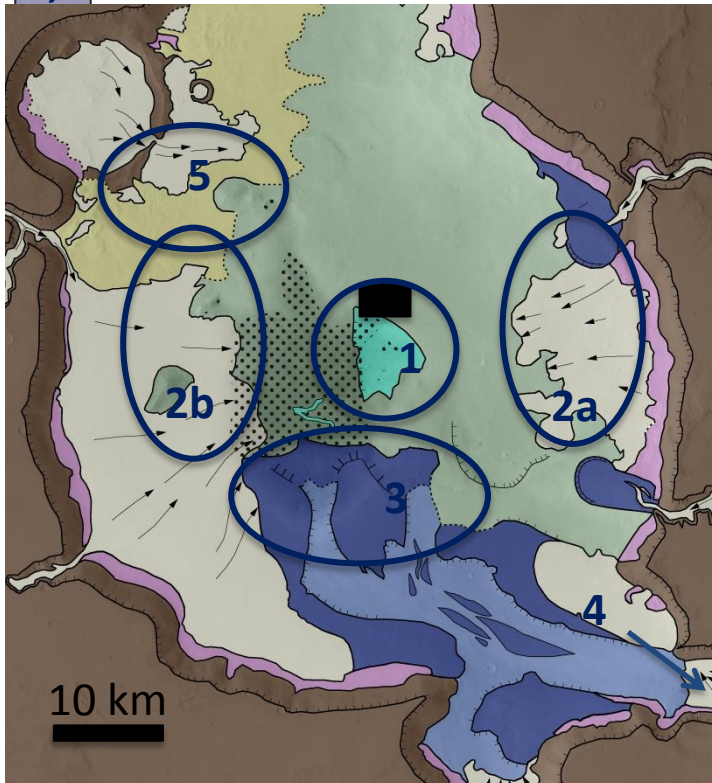


- Three delta fans (blue on map) (*Ori et al, 2000*)
 - HRSC topography consistent With a delta plain and a steep front
 - The three fans have a plateau at the same elevation (-3100 m)
- ⇒ **Consistent with coeval activity in a past lake (>400 m deep)**

Scientific objectives

1st EZ Workshop for Human Missions to Mars

- | | |
|--|--|
| 2 Glacial landforms | Geologic map caption |
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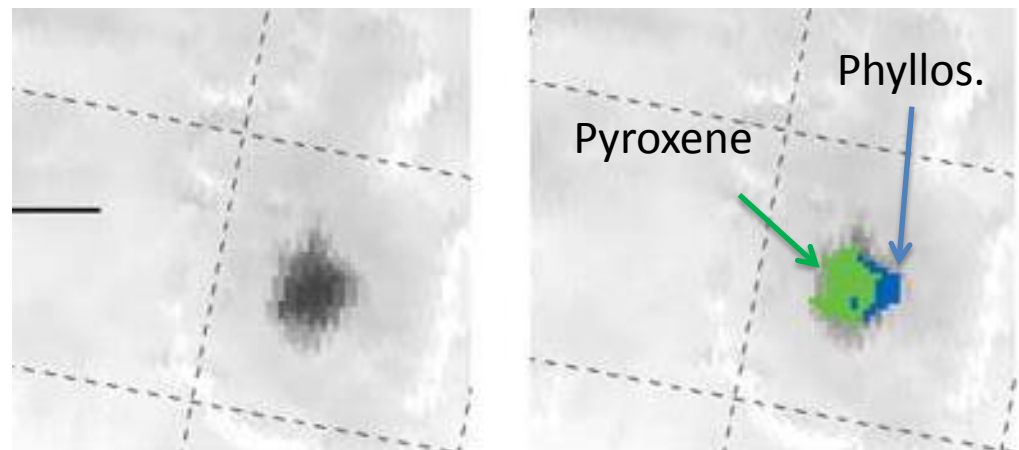


Dehouck et al., Planet. Spa. Sci., 2010

A paleolake with clay minerals in lake sediments

Specific type of clay minerals on dark terrains
(Poulet et al, 2005, OMEGA/Mars Express)




Actually just darker than the surroundings
No high resolution images at that time



Scientific objectives

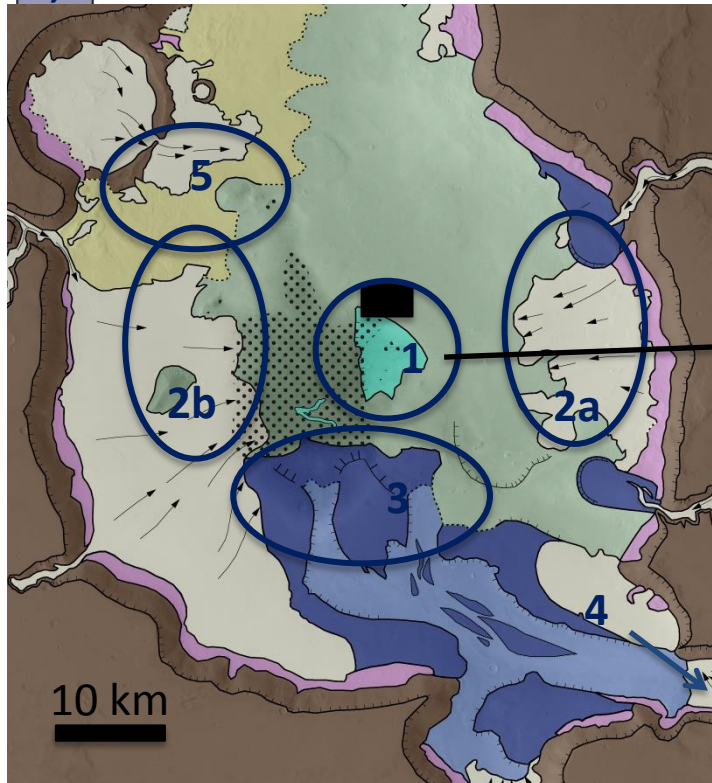


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A paleolake with clay minerals in lake sediments

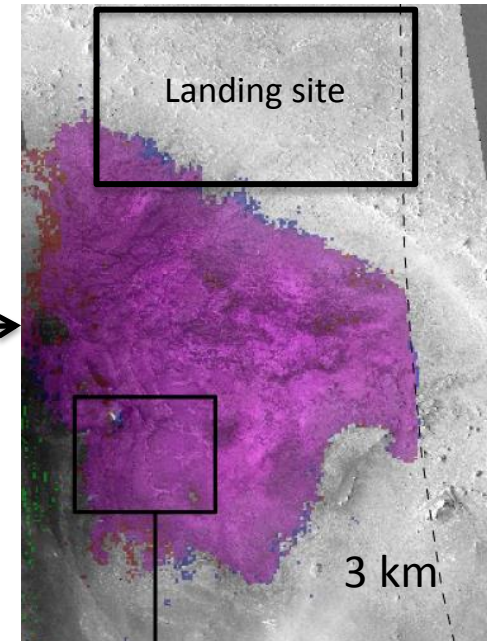
CRISM spectral map
(Dehouck et al, 2010)



Fe-Mg phyllosilicates
(likely smectites)

Correlation with
erosional window of
layered deposits




Clay minerals consistent with fine-grained
deposits at lake bottom

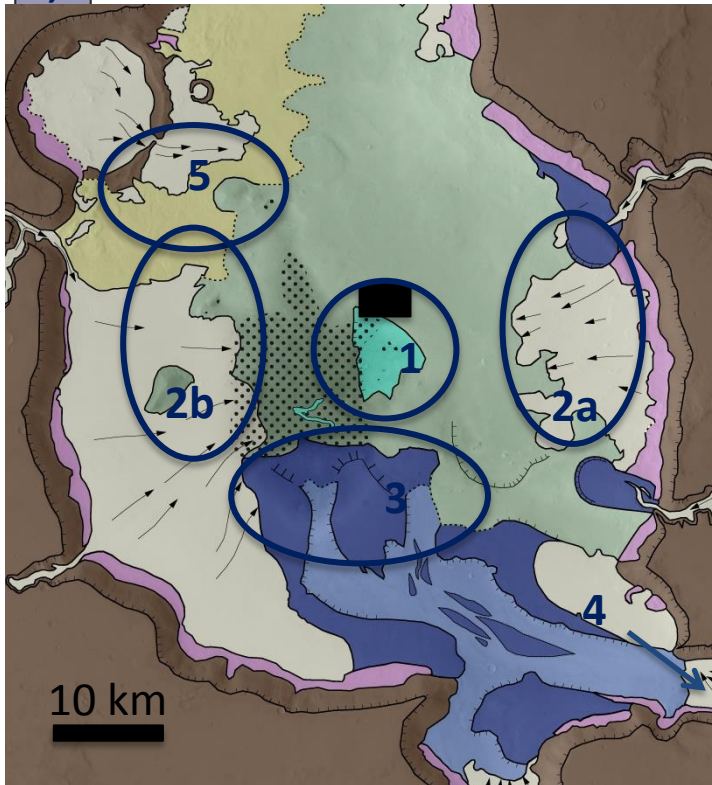


Science ROI 1

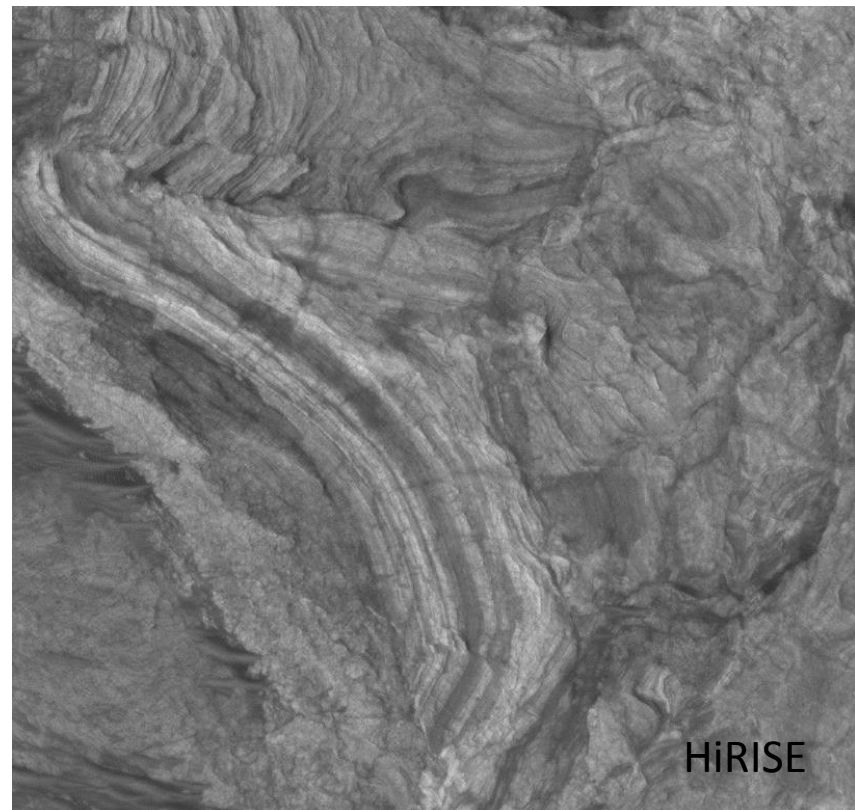


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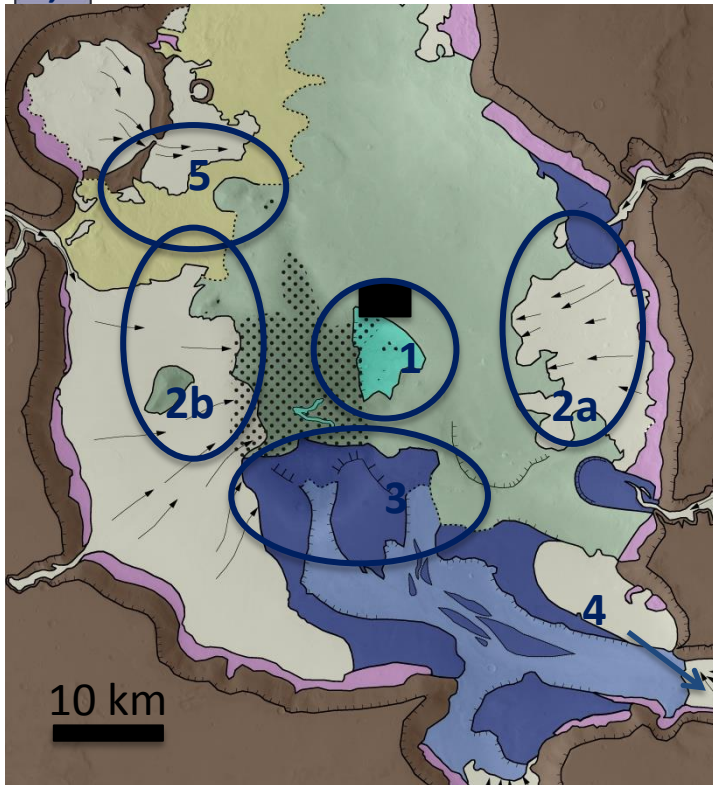
Close-up on clay-rich layered deposits



Science ROI 2a

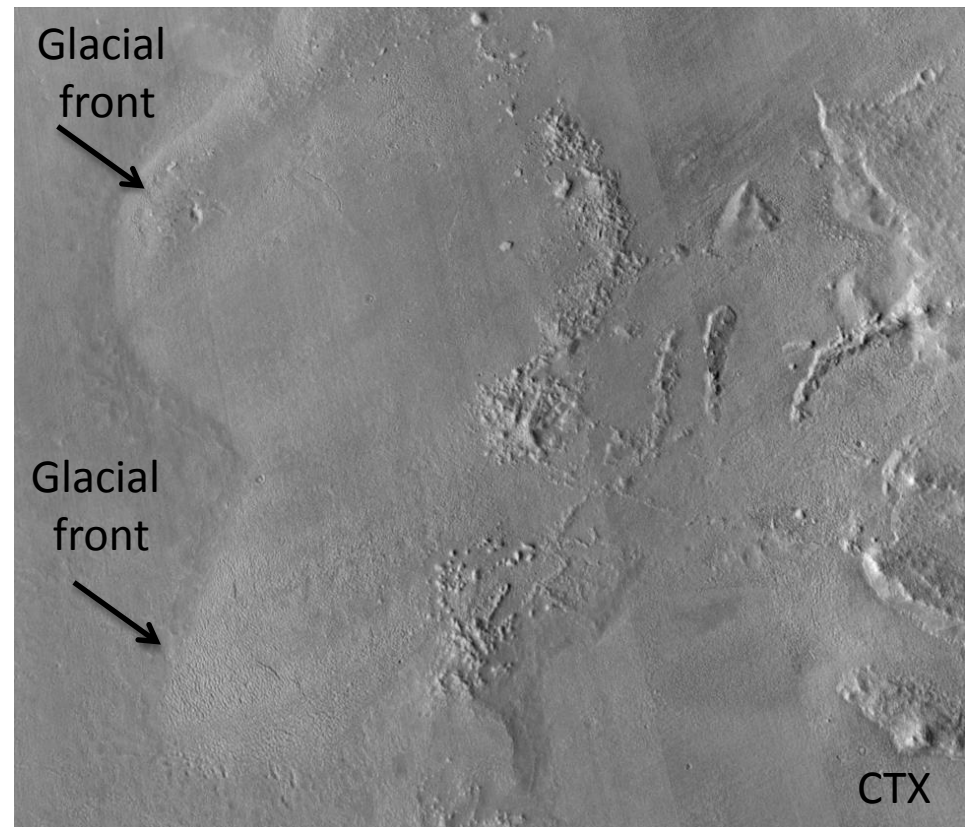
1st EZ Workshop for Human Missions to Mars

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


Dehouck et al., Planet. Spa. Sci., 2010

Lobate debris aprons 10 km east of the landing zone

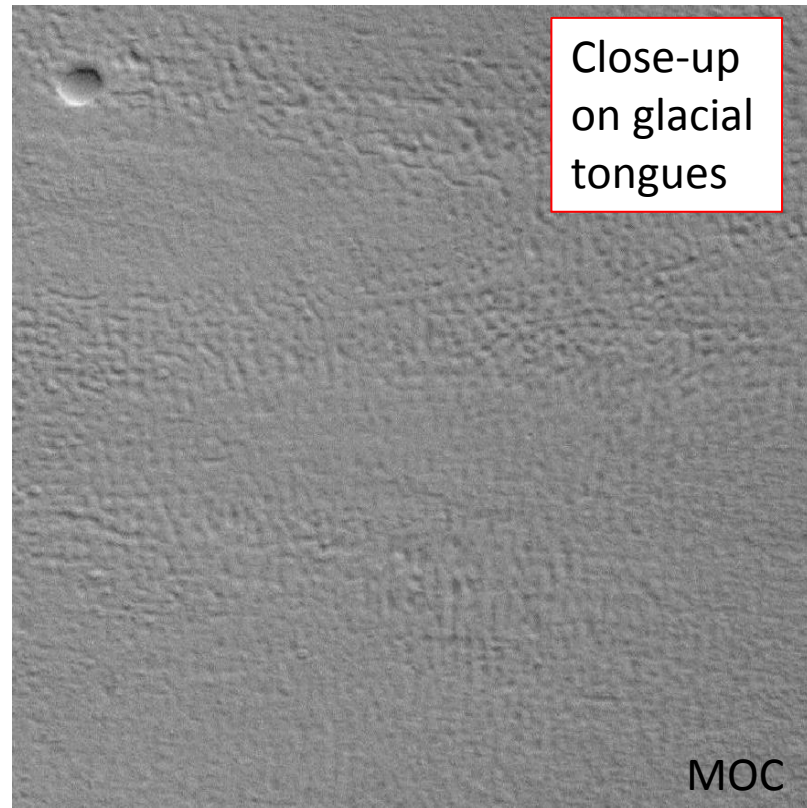
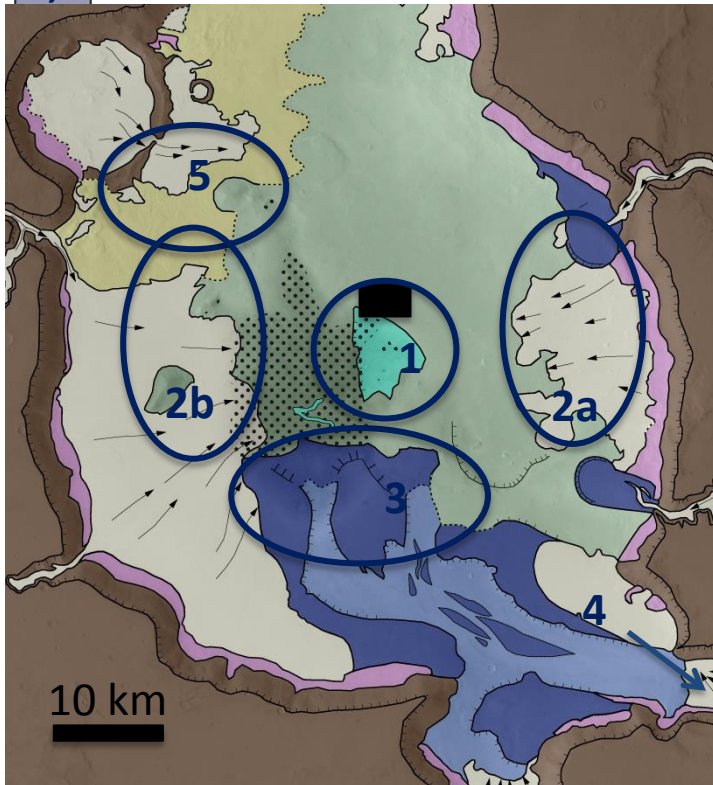


Science ROI 2a

1st EZ Workshop for Human Missions to Mars




- | | |
|--|--|
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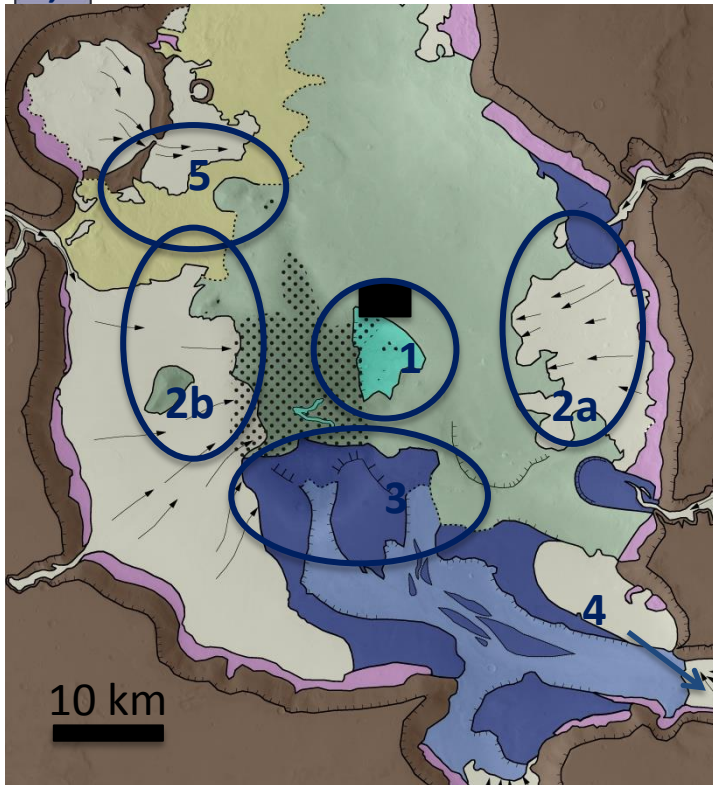
Pitted texture typical of sublimation of ice (Mangold, 2003)
Similar to Deuteronilus glaciers (Head et al., this morning)



Science ROI 2b

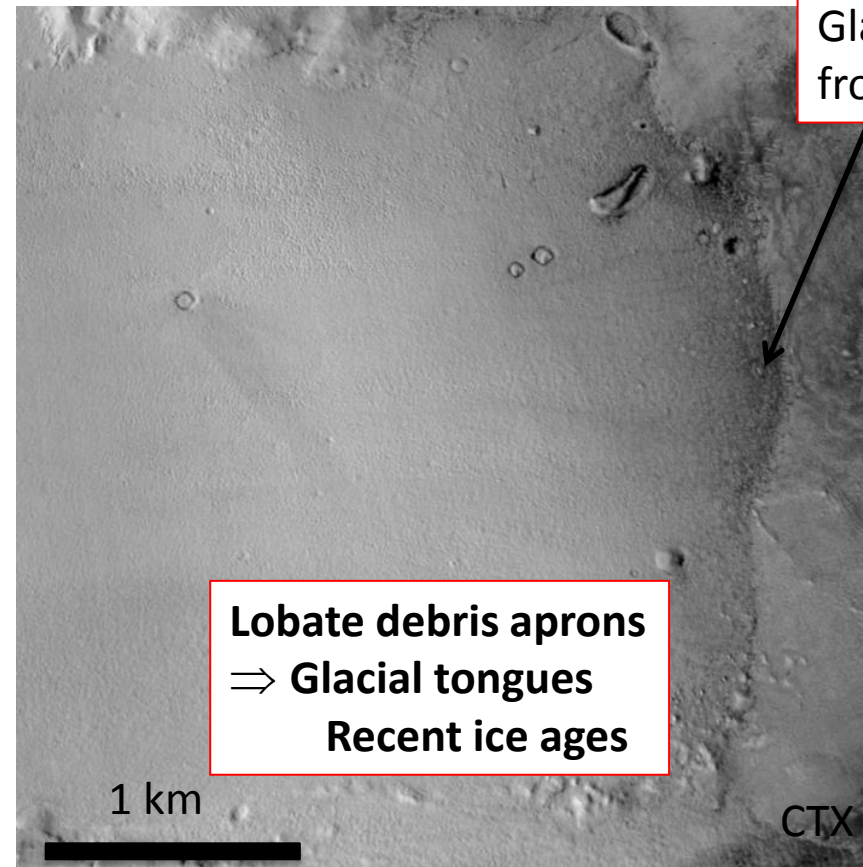
1st EZ Workshop for Human Missions to Mars

- | | | |
|------------|-------------------------------|--|
| 2 | Glacial landforms | Geologic map caption |
| 5 | Modified ejecta blanket |  Depression floor |
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Dehouck et al., Planet. Spa. Sci., 2010

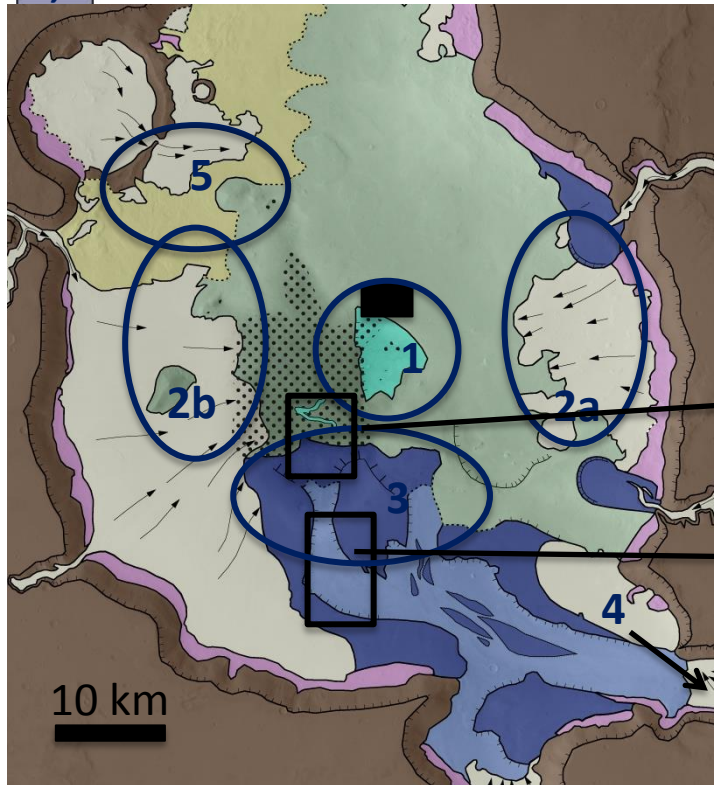
Lobate debris apron 15 km west of the landing zone



Science ROI 3, 4

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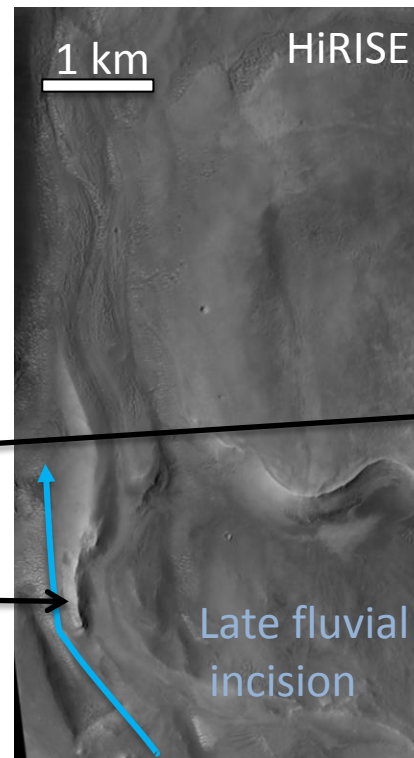
- | | |
|--|--|
| 2 Glacial landforms | Geologic map caption |
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Dehouck et al., Planet. Spa. Sci., 2010

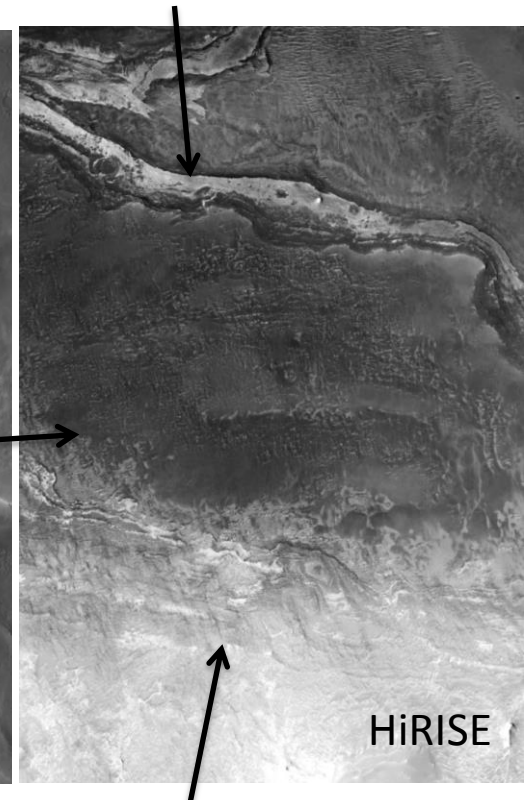
Fluvial and deltaic deposits from Mamers Vallis

Fluvial bars



Flow direction

Clay minerals in some layers

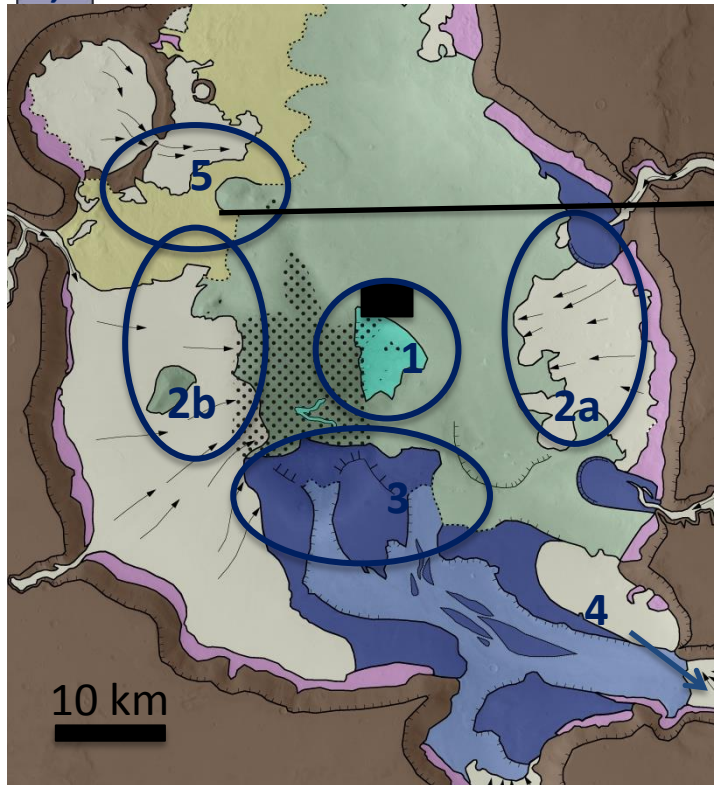


Layers at delta front

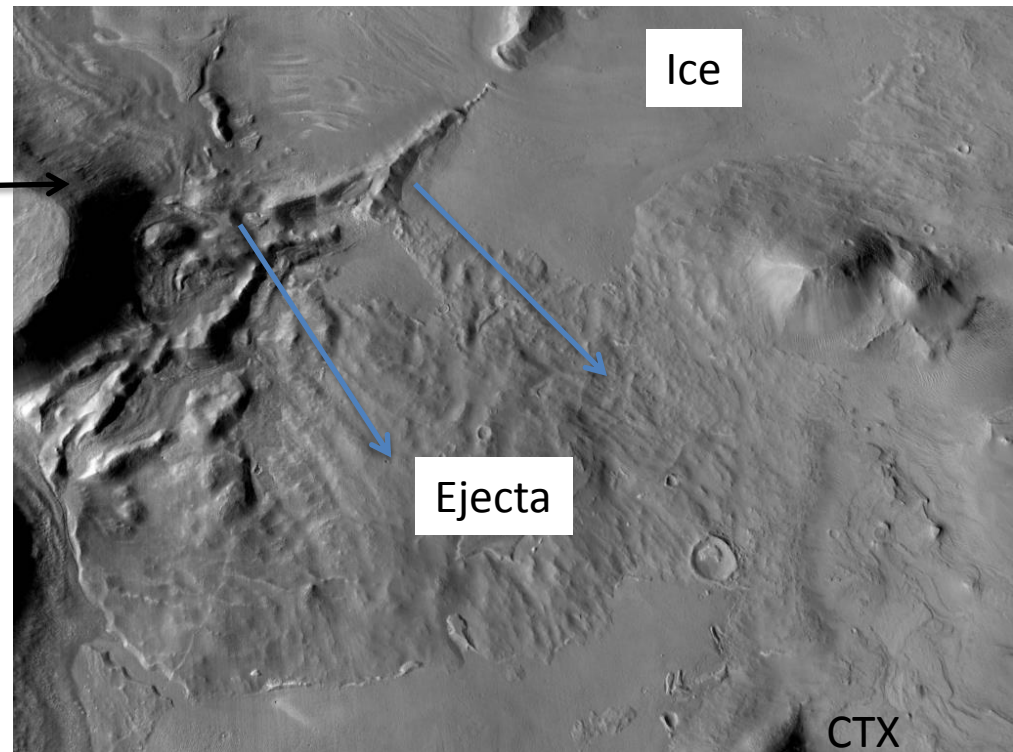
Science ROI 5

1st EZ Workshop for Human Missions to Mars

- | | | |
|------------|-------------------------------|--------------------------------------|
| 2 | Glacial landforms | Depression floor |
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| 3,4 | Channel in the delta deposits | Noachian plateau |
| 3,4 | Delta deposits | |

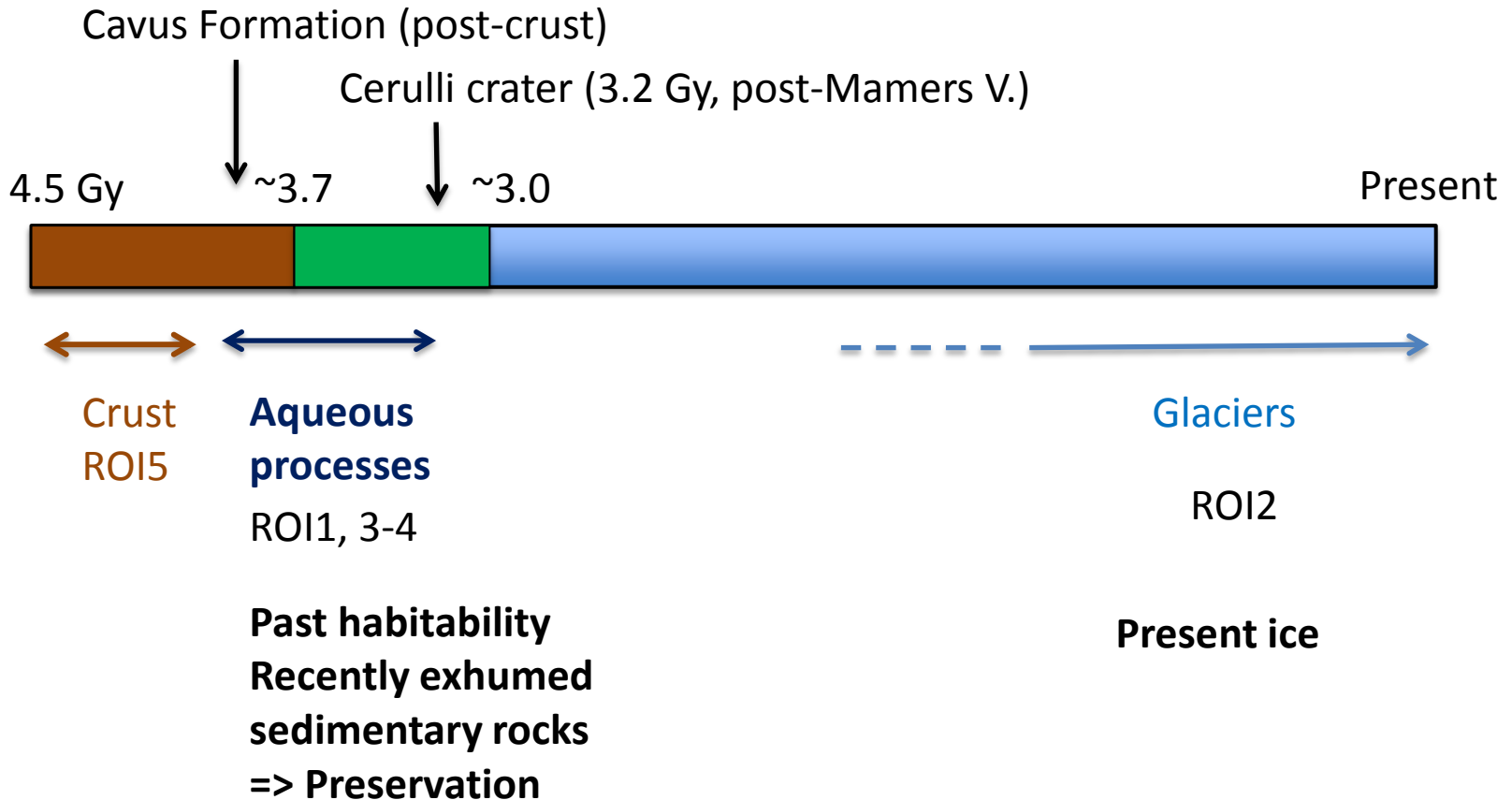


Ejecta from craters: Access to Noachian crustal rocks
Limitation: Maybe covered by ice



Science ROIs Summary: Range of geologic time

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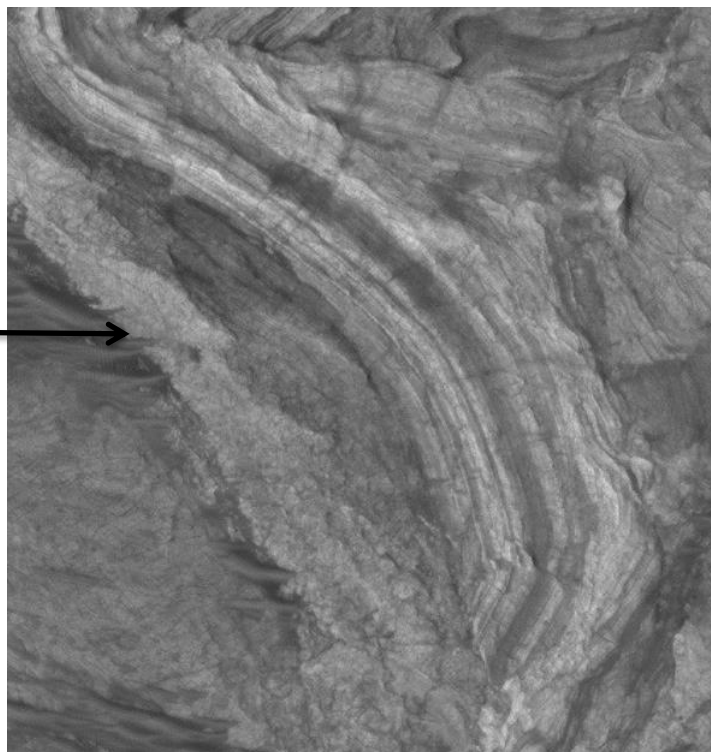
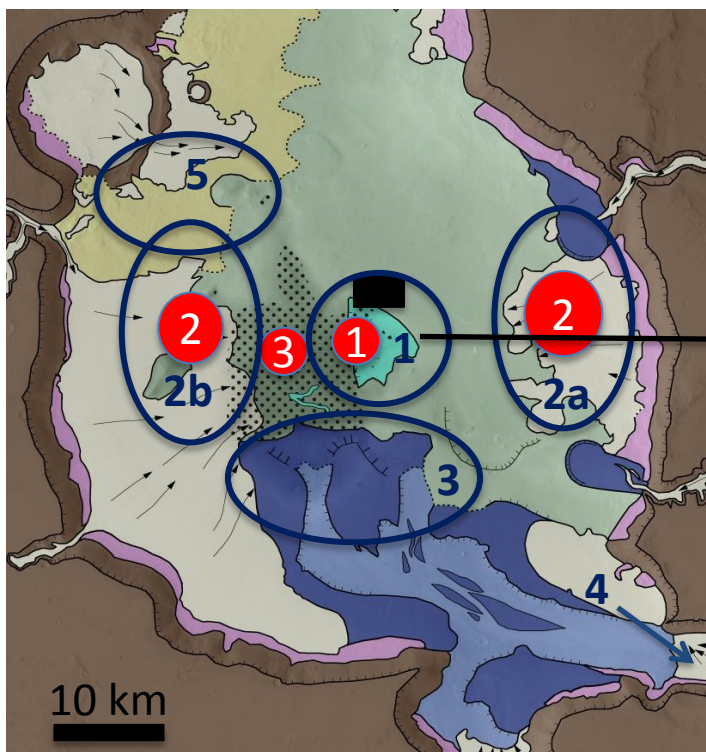


Resource ROI 1

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Clay rich deposits contain water

e.g., saponite:



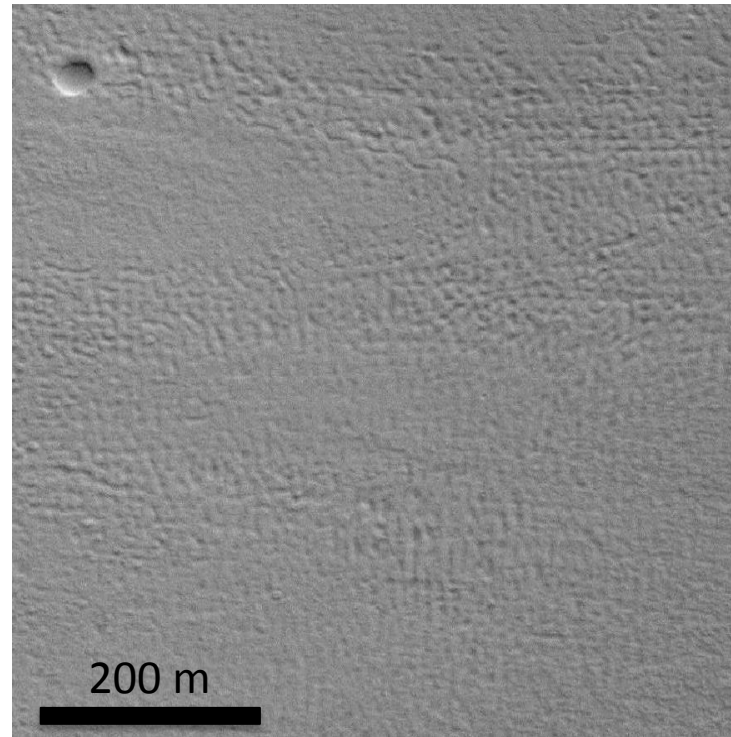
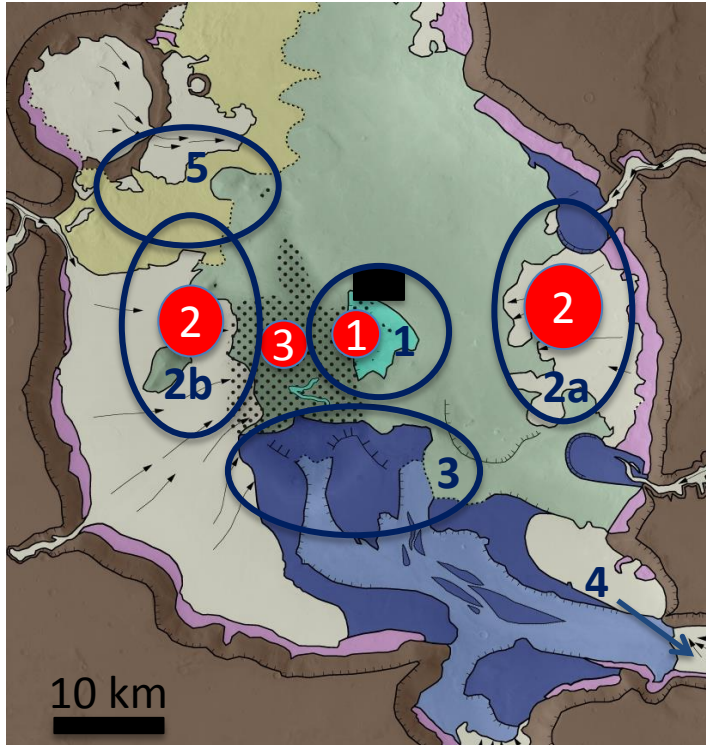
Replace With: EZ Location Name

Resource ROIs 2a and 2b

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Glacial deposits contain ice

Texture with some sublimation but
no intense sublimation
suggests ice likely near surface ($\ll 10$ m)

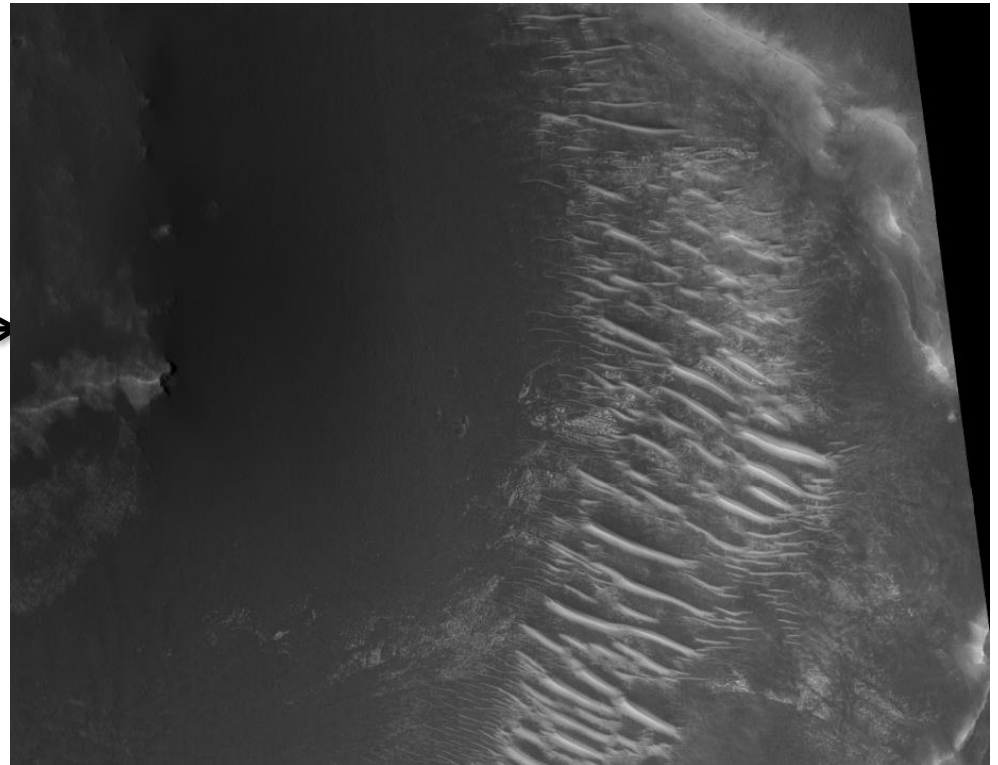
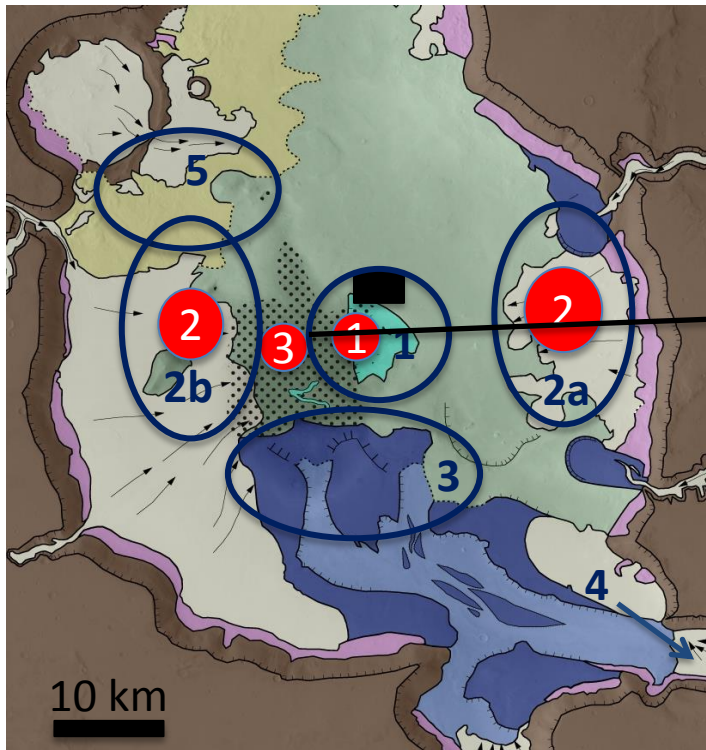


Resource ROI 3

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Area of sand few kms west of the landing zone

Mobile material for construction (composition is pyroxene rich from spectral data)



Resource ROIs Summary

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- Two main resources for water:
 - Clay minerals near the landing site proposed
 - Water ice 10 km of potential landing site
- Mobile material for constructions close to landing site

Science ROI(s) Rubric

1st EZ Workshop for Human Missions to Mars

Site Factors					SROI1	SROI2	SROI3	SROI4	SROI5	RROI1	RROI2	RROI3	EZ SUM
Science Site Criteria	Astrobio	Threshold	AND/OR	Potential for past habitability	●		●	●		●			4,0
				Potential for present habitability/refugia		?					?		0,2
		Qualifying		Potential for organic matter, w/ surface exposure	●		●	○		●			3,1
	Atmospheric Science	Threshold		Noachian/Hesperian rocks w/ trapped atmospheric gases	●		●		○	●			3,1
		Qualifying		Meteorological diversity in space and time	?	?	○			?	?		0,5
				High likelihood of surface-atmosphere exchange		●					●	●	3,0
				Amazonian subsurface or high-latitude ice or sediment		●					●		2,0
				High likelihood of active trace gas sources									
	Geoscience	Threshold		Range of martian geologic time; datable surfaces	●		?			●			2,1
				Evidence of aqueous processes	●		●	●		●			4,0
				Potential for interpreting relative ages	●	?			○	●	?		2,3
		Qualifying		Igneous Rocks tied to 1+ provinces or different times									
				Near-surface ice, glacial or permafrost		●					●		2,0
				Noachian or pre-Noachian bedrock units	○				●	○			1,2
				Outcrops with remnant magnetization									
				Primary, secondary, and basin-forming impact deposits									
				Structural features with regional or global context	?					?			0,2
				Diversity of aeolian sediments and/or landforms	●					●		●	3,0

Key	
●	Yes
○	Partial Support or Debated
	No
?	Indeterminate

Resource ROI(s) Rubric

1st EZ Workshop for Human Missions to Mars

Site Factors				SROI1	SROI2	SROI3	SROI4	SROI5	RROI1	RROI2	RROI3	EZ SUM			
ISRU and Civil Engineering Criteria	Engineering		Meets First Order Criteria (Latitude, Elevation, Thermal Inertia)												
	Water Resource	Threshold	AND/OR	Potential for ice or ice/regolith mix											2,0
				Potential for hydrated minerals											2,2
				Quantity for substantial production											4,1
			Potential to be minable by highly automated systems											0,2	
			Located less than 3 km from processing equipment site											2,0	
			Located no more than 3 meters below the surface											2,4	
			Accessible by automated systems											2,2	
		Qualifying	Potential for multiple sources of ice, ice/regolith mix and hydrated minerals											2,1	
			Distance to resource location can be >5 km											3,0	
			Route to resource location must be (plausibly) traversable											2,2	
		Civil Engineering	Threshold	~50 sq km region of flat and stable terrain with sparse rock distribution											2,0
	1–10 km length scale: <10°											4,2			
	Located within 5 km of landing site location											2			
	Qualifying		Located in the northern hemisphere											8,0	
			Evidence of abundant cobble sized or smaller rocks and bulk, loose regolith											1,3	
	Food Production	Qualifying	Utilitarian terrain features												
			Low latitude												
			No local terrain feature(s) that could shadow light collection facilities											5,0	
			Access to water											4,0	
	Metal/Silicon Resource	Threshold	Access to dark, minimally altered basaltic sands											1,0	
			Potential for metal/silicon											0,4	
			Potential to be minable by highly automated systems											1,2	
			Located less than 3 km from processing equipment site											1,2	
			Located no more than 3 meters below the surface											1,0	
		Qualifying	Accessible by automated systems											1,0	
			Potential for multiple sources of metals/silicon												
	Distance to resource location can be >5 km											1,0			
	Route to resource location must be (plausibly) traversable														

Key	
●	Yes
○	Partial Support or Debated
	No
?	Indeterminate

Highest Priority EZ Data Needs

1st EZ Workshop for Human Missions to Mars



- High resolution **stereo** imagery on glacial flows
(both for Resource and Science ROI2)
- High resolution imagery on Mammers Vallis outlet
(for Science ROI4 and for navigation)

Conclusion:

**A unique location on Mars with
both present ice and past lake sediments with clay minerals**

BACKUP SLIDES

Prioritization List of EZ Data Needs

1st EZ Workshop for Human Missions to Mars



- Provide a prioritized list of orbiter/rover data to be collected to assess the science potential of the EZ.
- Provide a prioritized list of orbiter/rover data to be collected to assess the resource potential of the EZ.
- This data could be either from a current or future asset.
- If data to be collected are from existing assets please indicate:
 - HiRISE
 - CRISM
 - THEMIS
 - other

Provide a short justification as to what questions this will address.